APPENDIX

A

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[Name of Document] SPECIFICATION

[Title of the Invention] LOCATING UNIT AND VEHICLE BODY ASSEMBLY MACHINE USING THE SAME

[Claim for a Patent]

[Claim 1] A locating unit equipped with a locating pin to be inserted through a locating bore formed in a work for positioning and supporting said work, wherein

said locating pin has a root portion formed with a work seating surface, which is provided with a work seating detection means for detecting the presence of seating of said work.

[Claim 2] The locating unit according to claim 1, comprising a clamp means internally located in said locating pin for clamping said work positioned with said locating pin.

[Claim 3] The locating unit according to claim 1 or 2, wherein

said work seating detection means includes a detection pin which can protrude or retract from the work seating surface and is operative to detect the presence of seating of said work in response to a protruding or retracting movement of said detection pin caused by a seating or unseating phase of said work.

[Claim 4] A vehicle body assembly machine, comprising the locating unit according to any one of claims 1 to 3 as a locating unit, for implementing a relative positioning operation among a plurality of panel-shaped works, which form a part of a vehicle body of an automobile, prior to welding and joining said plurality of works, the vehicle body assembly machine comprising:

locators independently mounted for respective works, each including the locating unit mainly constructed of a locating pin for positioning and supporting said works, and

having a function of arbitrarily altering at least a two-dimensional position of the locating unit by an autonomous operation, wherein

the locating units are individually made to perform an advancing and retreating movement by the autonomous operation of each locator between a work setting position where said works are set with respect to each locator and a relatively positioning completion location where said respective works are finally relatively positioned, to perform the relative positioning operation between said respective works.

[Claim 5] The vehicle body assembly machine according to claim 4, wherein

each of said respective locators has an operating degree of freedom in orthogonal three axes to enable a three-dimensional position of the relevant locating unit to be arbitrarily altered by the autonomous operation.

[Claim 6] The vehicle body assembly machine according to claim 5, wherein

said plurality of locators are provided for each of said works, and are mutually synchronized when said works are relatively positioned, so that the locating unit is caused to perform the advancing and retreating movement.

[Claim 7] The vehicle body assembly machine for implementing a relative positioning operation among a plurality of panel-shaped works, which form a part of a vehicle body of an automobile, prior to welding and joining said plurality of works, the vehicle body assembly machine comprising:

locators independently mounted for respective works, each including the locating unit mainly constructed of a locating pin for positioning and supporting said works, and having a function of arbitrarily altering at least a two-dimensional position of the locating unit by an autonomous operation, wherein

the locating units are individually made to perform an advancing and retreating movement by the autonomous operation of each locator between a work set position where said works are set with respect to each locator and a relatively positioning completion location where said respective works are finally relatively positioned, to perform the relative positioning operation between said respective works.

[Detailed Description of the Invention]

[0001]

[Field of the Invention]

The present invention relates to a locating unit for use in positioning works in a vehicle body assembly process, etc. of an automobile, and a vehicle body assembly machine using the locating unit.

[0002]

[Prior Art]

As vehicle body transporting accommodations in a vehicle body assembly process of an automobile, as disclosed in Japanese Patent No. 274584, for example, it is publicly known that a plurality of locator main bodies having an operating degree of freedom in X, Y and Z orthogonal three axes are arranged on a transfer truck, and as shown in Fig. 13, each locator main body is individually provided with a locating unit 101 having a locating pin 102 and a clamp arm 103, and a specific panel is clamped for positioning by a plurality of the locating units 101 to transport.

[0003]

As shown in Fig. 13, in order to detect whether or not the locating pin 102 in each locating unit 101 is reliably inserted into a locating bore 104 of a panel W11 as a mating side and the panel W11 is seated in the locating pin 102, a seating detection means 105 such as a proximity switch or the like is disposed adjacent to the locating pin 102 through a bracket 106, and the seating detection means 105 detects a seating or unseating state of the panel W11.

[0004]

Incidentally, an embossed portion 108 seated in a work seating surface 107 of the locating pin 102 is formed in the panel side W11 in a concentric manner with the locating bore 104, and further if the embossed portion 108 is regularly seated on the work seating surface 107, it is clamped by the clamp arm 103 having a built-in locating pin 102.

[0005]

[Problems to be Solved by the Invention]

In the aforementioned conventional structure, a three-dimensional position of the locating pin 102 can be altered by using an operating degree of freedom in orthogonal three axes of the locator main body, which can cope with positioning of a panel of another type of vehicle. However, since a mounting position of the seating detection means 105 disposed adjacent to the locating pin 102 is set in response to a panel shape, each time the panel is altered in response to a change of a vehicle type, the seating detection means 105 is required to remodel and does not suffice in view of general-purpose properties.

[0006]

More specifically, for example, when the shape of the panel to be positioned and supported by the locating pin 102 is altered to W12 as shown by a virtual line of Fig. 13, as the seating detection means 105 projects largely to outside of the locating pin 102 together with the bracket 106, the seating detection means 105 still at the previous mounting position interferes with the panel W12 and consequently the mounting position of the seating detection means 105 is required to alter every time in response to the shape of the altered panel W12, unfavorably resulting in demanding the surplus number of steps for remodeling accommodations.

[0007]

Further, when a region close to the seating detection means 105 is to be welded by, for example, a spot welding gun gripped by a welding robot, or when a traveling locus of the spot welding gun is set in a region close to the seating detection means 105, it is similarly feared that the spot welding gun interferes with the seating detection means 105, and similarly to the above, a mounting form of the seating detection means 105 is required to remodel every time. Occasionally, the traveling locus of the spot welding gun, i.e. teaching data has to be corrected, which is not preferable in practical use.

[0008]

On the other hand, it is desirable that the vehicle body assembly machine itself is further simplified or reduced in a necessary space from a viewpoint of the general-purpose properties.

[0009]

The present invention has been made by paying attention to the above problems, and it is an object of the invention to

provide a locating unit in which a locating pin as well as a seating detection means accessory thereto can be set so as to cope with a multi-type of work, thereby intending to make a general-purpose locating unit in a true sense as a whole including the locating pin and the seating detection means, and a vehicle body assembly machine using the locating unit.

[0010]

[Means for Solving the Problems]

According to a first aspect of the present invention, in the locating unit equipped with a locating pin to be inserted through a locating bore formed in a work for positioning and supporting the work, the locating pin has a root portion formed with a work seating surface, which is provided with a work seating detection means for detecting the presence of seating of the work.

[0011]

The work seating detection means may be of any types such as a contact type, a non-contact type, a photoelectric type or an air pressure type, provided that a detection portion of the work seating detection means is exposed to the work seating surface of the root portion of the locating pin to detect a seating or unseating state of the work relative to the work seating surface in a turned-on or turned-off state.

[0012]

Further, according to a second aspect of the present invention, preferably, a clamp means such as a clamp arm or the like is internally provided in the locating pin for clamping the work positioned with the locating pin.

[0013]

Accordingly, according to the first and second aspects of the present invention, when the locating pin is inserted into the locating bore on the work side as a mating side and the work is seated on the work seating surface, the work is positioned by a mutual fitting between the locating pin and the locating bore, and simultaneously the seating or unseating state of the work on the work seating surface is detected by the work seating detection means. Further, according to the second aspect of the present invention, after the work has been reliably positioned by the mutual fitting between the locating pin and the locating bore, the work is clamped by the built-in clamp means of the locating pin.

[0014]

Since the work seating detection means is provided on the work seating surface of the root portion of the locating pin, an occupied space becomes very small, and if a size of the locating pin and the locating bore has been in advance made in common irrespective of a difference in a species of the work, for example, the work seating detection means can be used in common for the plurality of works having different species together with the locating pin.

[0015]

According to a third aspect of the present invention, on the assumption of the first or second aspect of the present invention, the work seating detection means includes a detection pin which can protrude or retract from the work seating surface and is operative to detect the presence of seating of the work in response to a protruding or retracting movement of the detection pin caused by a seating or unseating phase of the work.

[0016]

For example, a tip end of the detection pin which protrudes or retracts from the work seating surface and an end portion opposite to the tip end are opposed to a microswitch or a proximity switch, and the protruding or retracting state of the detection pin is detected at a position apart from the work seating surface.

[0017]

Accordingly, according to the third aspect of the present invention, since the seating or unseating state of the work is mechanically detected by the protruding or retracting operation of the detection pin, reliability in the seating detection is raised.

[0018]

According to a fourth aspect of the present invention, on the assumption of the vehicle body assembly machine for implementing a relative positioning operation among a plurality of panel-shaped works, which form a part of a vehicle body of an automobile, prior to welding and joining the plurality of works, the vehicle body assembly machine comprises: locators independently mounted for respective works, each including the locating unit mainly constructed of a locating pin for positioning and supporting the works, and having a function of arbitrarily altering at least a two-dimensional position of the locating unit by an autonomous operation, wherein the locating units are individually made to perform an advancing and retreating movement by the autonomous operation of each locator between a work set position where the works are set with respect to each locator and a relatively positioning completion location where the respective works are finally relatively

positioned, to perform the relative positioning operation between the respective works. The vehicle body assembly machine comprises the locating unit according to any one of claims 1 to 3 as a locating unit.

[0019]

According to a fifth aspect of the present invention, preferably, each of the respective locators has an operating degree of freedom in orthogonal three axes to enable a three-dimensional position of the relevant locating unit to be arbitrarily altered by the autonomous operation. Further, the advancing and retreating movements of the locating unit contain a one-dimensional operation as well as a two-dimensional operation or a three-dimensional operation.

[0020]

Similarly, according to a sixth aspect of the present invention, it is desirable for stability in positioning the work that the plurality of locators are provided for each of the works, and are mutually synchronized when the works are relatively positioned, so that the locating unit is caused to perform the advancing and retreating movement.

[0021]

Further, as the form of relative positioning between the plurality of works, in an example that a large-scaled work as the kernel is used as a standard and a plurality of relatively small works are assembled to the large-scaled work to relatively position, a work set position and a positioning completion location of the work serving as the kernel are at the same position, to be positioned and fixed at a substantially fixed position. The other works are approached to the work serving as the kernel, so that the works may be positioned relatively

to each other.

[0022]

Accordingly, according to the fourth to sixth aspects of the present invention, the two-dimensional position or the three-dimensional position which is required at the work setting position and the positioning completion location in each locator has been previously stored and set, and the corresponding work of each locator which stands by at the work setting position is set by a handling robot or a handwork to position and support. In this case, when a specific work is set by, for example, an operator's handwork, the corresponding locator of the work can be positioned at a position where the operator is easy to operate the locating unit.

[0023]

Each locating unit is caused to make the advancing and retreating movements, namely an approach operation, from the work setting position to the positioning completion location by using an operating degree of freedom in the two-dimensional or three-dimensional level of the locator itself. If the locating unit of each locator is positioned to a relatively positioning completion location, this state indicates a completion of the relatively positioning between the plurality of works, and for example, the relatively positioning state is held while the spot welding gun is welded.

[0024]

According to a seventh aspect of the present invention, on the assumption of the vehicle body assembly machine for implementing a relative positioning operation among a plurality of panel-shaped works, which form a part of a vehicle body of an automobile, prior to welding and joining the plurality of

works, the vehicle body assembly machine comprises: locators independently mounted for respective works, each including the locating unit mainly constructed of a locating pin for positioning and supporting the works, and having a function of arbitrarily altering at least a two-dimensional position of the locating unit by an autonomous operation, wherein the locating units are individually made to perform an advancing and retreating movement by the autonomous operation of each locator between a work setting position where the works are set with respect to each locator and a relatively positioning completion location where the respective works are finally relatively positioned, to perform the relative positioning operation between the respective works.

[0025]

Accordingly, according to the seventh aspect of the present invention, each locator functions similarly to that according to the fourth aspect of the present invention excluding the function of the locating unit itself.

[0026]

[Effects of the Invention]

According to the first aspect of the present invention, since the work seating detection means for detecting the seating of the work on the work seating surface is provided on the work seating surface on the root portion side of the locating pin, nothing is projected surrounding the locating pin unlike the prior art and by only the region of the locating pin substantially, the positioning function and the seating detection function can be exhibited by the locating pin. Accordingly, if a size of the locating pin and the locating bore has been previously unified irrespective of a difference in a species of the work, the locating pin as well as the work seating

detection function can be used in common for a plurality of types of works, thereby raising the general-purpose properties, and it is not necessary at all to remodel accommodations followed by a work alteration unlike the prior art.

[0027]

According to the second aspect of the present invention, since the clamp means for clamping the work is provided inside the locating pin, a work clamp function in addition to the locating pin function and the work seating detection function is also collected by using the locating pin as the kernel. In addition to the same effects as in the first aspect of the present invention, it is advantageous in that a reduction in the size and space of the locating pin with the clamp function can be further attained.

[0028]

Further, according to the third aspect of the present invention, since the work seating detection means mechanically detects the seating state in response to the protruding and retracting operation of the detection pin followed by the seating and unseating of the work, in addition to the same effects as in the first or second aspect of the present invention, the more reliable detection is enabled and there is an advantage of increasing reliability in the seating detection.

[0029]

According to the fourth aspect of the present invention, the vehicle body assembly machine is constituted by the plurality of locators having a function of arbitrarily altering at least the two-dimensional position of the locating unit equipped at the tip end by the autonomous operation, and the locating unit is caused to individually make the advancing and

retreating movement by the autonomous operation by using at least the two-dimensional operating degree of freedom included in each locator to relatively position the respective works. Therefore, it is unnecessary to form a shift unit for relatively positioning the works positioned and supported by the locators separately from each locator, and there is an effect that a simplification and a reduction in a size and a considerable reduction in a space of accommodations can be intended to attain.

[0030]

Further, as the locating unit according to any one of the first to third aspects of the present invention is adopted, it is easy to confirm the presence or absence of the work (detection of lacking works) with respect to the locators by using the seating detection function. Therefore, reliability is raised as the vehicle body assembly machine, and it is possible to attain the general-purpose function of detecting lacking works. In addition, since the work setting position for each locator can arbitrarily be altered as required, for example, when the work is set to the locator by a handwork, the work setting position can be set to an optimum position conforming to an operator's physique or the like and can be set well in view of workability.

[0031]

According to the fifth aspect of the present invention, since each locator has the operating degree of freedom in orthogonal three axes, in addition to the same effects as in the fourth aspect of the present invention, it is advantageous in that the degree of freedom as well as the general-purpose properties as the vehicle body assembly machine increases still more.

[0032]

According to the sixth aspect of the present invention, when the plurality of locators are relatively positioned between the works, the locating units are caused to mutually synchronously make the advancing and retreating movements. Therefore, in addition to the same effects as in the fifth aspect of the present invention, it is advantageous in that stability in positioning the work at the time of relatively positioning is stepwise enhanced.

[0033]

According to the seventh aspect of the present invention, since the remaining structure other than the locating unit is basically equalized to the fourth aspect of the present invention, the same effects as in the fourth aspect of the present invention can be obtained.

[0034]

[Preferred Embodiments]

Fig. 1 is a schematic plan view of a vehicle body assembly machine, including a locating unit according to a preferred embodiment of the present invention, and shows an example of a unit for performing relative positioning among four component parts, involving a dash lower panel (hereinafter referred to simply as a lower panel or a panel) W1 which serves as a work, a substantially C-shaped dash cross member (hereinafter referred to simply as a cross member or a panel) W2 which also serves as a work and a pair of right and left cowl top side panels (hereinafter referred to simply as side panels or panels, respectively) W3, W4 all of which form the kernel of a constituent element of a dash panel D of an automobile, to obtain a ready state available for welding and joining prior to welding

and joining steps of these component parts with respect to one another by spot welding.

[0035]

Under a condition wherein the dash panel D is assembled as a part into a vehicle body, the cross member W2 is located on the lower panel W1 which separates a passenger compartment from an engine room, with the side panels W3, W4 being located at both sides of the lower panel 1 and the cross member W2.

[0036]

The vehicle body assembly machine shown in Fig. 1 is generally comprised of a jig base 1 serving as a center of a locator jig J, a first work table 2 in which the lower panels W1 are aligned and stacked, a second work table 3 in which the cross members W2 and the side panels W3, W4 are aligned and stacked other than the lower panel W1, a handling robot 4 of a floor mount type, and a plurality of welding robots 5 (only one set of welding robots being shown in Fig. 1) of tray styles mounted at an upper area of the jig base 1.

[0037]

The lower panel W1 stacked on the first work table 2 is gripped by the handling robot 4 and is positioned at a relative positioning final location P1 on the jig base 1. Upon a completed positioning step of the lower panel 1, an operator M transfers a set of the cross member W2 and the pair of right and left side panels W3, W4 on the second work table 3 to work set positions P2, P3 on the jig base 1 for carrying out a primary positioning step. Then, when the operator M presses a given start switch, an autonomous operation to be described later of the locator jig allows the lower panel W1 and the cross member W2 and the pair of right and left side panels W3, W4 to be

subjected to a mutual relative positioning operation at the relative positioning final location P1 to permit the welding robot 5 to perform a spot welding process. Also, depending on car models, it is possible for the cross member W2 or the side panels W3, W4 to be positioned with respect to the jig base 1 with the handling robot 4 commonly used for the lower panel W1.

[0038]

Fig. 2 shows a detailed structure of the locator jig J, Fig. 3 is a front view of Fig. 2, and Fig. 4 shows a right side view of Fig. 2. The jig base 1 is mounted with left and right locator pairs 6A, 6B and 7A, 7B for positioning the lower panel, a pair of locators 8A, 8B for positioning the cross member, locator pairs 9A, 9B and 10A, 10B for positioning side panels W3, W4. Each of these locators 6A, 6B to 10A, 10B is combined by an X-axis unit, a Y-axis unit and a Z-axis unit of a ball screw type driven by a NC motor, with the Z-axis unit being located at an uppermost area, which form a locator mother unit having such a form as a manipulator with an operating freedom in orthogonal three axis. In the locator mother unit, a distal end of the Z-axis unit is provided with a locating unit 27 mainly composed of a locating pin 26 to be described later, to form a locator. The respective locators 6A, 6B to 10A, 10B are independently operable from one another to enable an autonomous operation whereby each has a function to arbitrarily alter a three-dimensional position at a distal end of each locating unit 27. Further, in the locators 6A, 6B and 7A, 7B for positioning the lower panel, the locating pin 26 of each locating unit 27 is directed upward. On the contrary, in the respective locators 8A, 8B to 10A, 10B for positioning the cross member and the side panels, the locating pin 26 is transversely set.

[0039]

Among the plural locators 6A, 6B to 10A, 10B, a typical

example of a detailed structure of the locator 9A for positioning the side panel is described below in detail with reference to Figs. 5 to 7. The X-axis unit 15 is constructed of an X-axis motor 11, an X-axis base 13 which contains a ball screw 12 driven to rotate with the X-axis motor 11, and an X-axis slider 14 mounted on the X-axis base 13 for sliding movement with the ball screw 12. Likewise, the Y-axis unit 20 includes a Y-axis motor 16, a Y-axis base 18 slidably mounted on the X-axis slider 14 which contains a ball screw 17 driven to rotate with the Y-axis motor 16, and a Y-axis slider 19 mounted on the Y-axis base 18. Further, the Z-axis unit 25 includes a Z-axis motor 22, a Z-axis base 23 containing a ball screw driven to rotate with the Z-axis motor 22, the Z-axis base 23 being erected on the Y-axis slider 19 through the bracket 21, and a Z-axis slider 24 mounted on the Z-axis base 23. An upper distal end of the Z-axis slider 24 is transversely mounted with a locating unit 27 mainly composed of the locating pin 26 having a clamping function as will be described below. As will be apparent from the foregoing description, the locator 9A for positioning the side panel is enabled to arbitrarily alter the three-dimensional position of the locating pin 26 in associated relationship with the X-axis unit 15, the Y-axis unit 20 and the Z-axis unit 25. Also, the other respective locators basically have the same structures as that of the locator 9A with the locating unit 27 for positioning the side panel.

[0040]

As shown in Figs. 2 and 4, a pair of clamping units 28 are mounted on the jig base 1 at positions adjacent to the locator pair 6A, 6B and the locator pair 7A, 7B, respectively, for positioning the lower panel. Each of the clamping units 28 includes a post 29 which stands upright from the jig base 1, and a swing type clamper 31 at an upper distal end of the post 29 and having an air cylinder 30 for driving the clamper 31. The lower panel W1, which forms the kernel of the dash panel

D, is positioned and supported with the respective locators 6A, 6B and 7A, 7B and is simultaneously clamped with the pair of clampers 28.

[0041]

Figs. 8 to 10 show a detailed structure of the locating unit 27 to be mounted to the distal end of each of the locators 6A, 6B to 10A, 10B. The locating unit 27 includes a hollow cylindrical post section 33 having a mounting flange portion and a clamp cylinder 34 composed of an air cylinder or a hydraulic cylinder formed in a substantially rectangular pole shape and connected to the post section 33 in a concentric relationship. A tapered locating pin 26 is connected to a distal end of the post section 33 via a spacer 36 by means of a plurality of bolts 37 and has a root portion formed with a seating flange portion 35.

[0042]

The locating pin 26 is partially formed with an elongated slit 38 which penetrates through the locating pin 26 in a radial direction, and which communicates with an internal space of the post section 33 to allow a clamp arm 39, formed in a substantially key configuration shown in Fig. 11, to be inserted through the elongated slit 38 and the internal space of the post section 33 as a clamping means. A key-shaped distal end of the clamp arm 39 protrudes outward from an opening portion 40 formed at the base portion of the locating pin 26, and the other end of the clamp arm 39 is coupled to a piston rod 41 of the clamp cylinder 34. In addition, a substantially L-shaped recessed cam 42 is held in engagement with a fixed pin 43 radially and transversely extending from the post section 33. With such an arrangement, when expanding and contracting the clamp cylinder 34, the clamp arm 39 is caused to operate in a clamping and unclamping operation between a clamping position C1 and an

unclamping position C2. Especially, in the clamping state, the distal end of the clamp arm 39 and the seating flange portion 35 are brought into a clamped condition as shown in Fig. 9 to clamp a given panel such as the side panel W3.

[0043]

On the other hand, the mating panel W3, which is positioned with the locating pin 26, is formed with an embossed portion E so as to project around a circumferential periphery of a locating bore R through which the locating pin 26 is inserted. When the locating pin 26 and the locating bore R are mutually mated with one another and concurrently the embossed portion E is seated on the seating flange portion 35 on the locating pin 26 side to effectuate the final positioning of the locating pin 26.

[0044]

Inside the post section 33 of the locating unit 27, a shaft 44 with stepped axial portions is located in parallel with an axis of the locating pin 26 for sliding movement and is urged leftward as shown in Fig. 9 by means of a compression spring 45. A small diameter end of the shaft 44 is coupled to a coupling plate 46, to which a detection pin 47 is connected at a position offset from the shaft 44 and extends in parallel to the shaft 44 to allow the detection pin 47 to protrude or retract from the work seating surface 35a of the seating flange portion 35 on the locating pin 26 side. Further, in the absence of the panel W3 on the seating flange portion 35 with the detection pin 47 protruded from the seating flange portion 35, seating the given panel W3 on the seating flange portion 35 allows the detection pin 47 to retract in the seating flange portion 35 for thereby wholly retracting the shaft 44.

[0045]

Further, a proximity switch 48 is mounted at a location opposed to an end of a large diameter portion of the shaft 44 in the post section 33. As shown in Fig. 9, when the detection pin 47 is protruded from the seating flange portion 35 with the end of the large diameter portion of the shaft 44 remaining separated from the proximity switch 48, the proximity switch 48 is turned off. In contrast, as described above, if the detection pin 47 is retracted in the seating flange portion 35, the proximity switch 48 detects the proximity based on sliding movement of the shaft 44 in response to the retracted movement, so that the proximity switch 48 is turned on.

[0046]

That is, the shaft 44, the detection pin 47 and the proximity switch 48 constitute a work seating detection mechanism 49 which serves as a work seating detection means for detecting seating or unseating states of the panel W3 with respect to the seating flange portion 35. Therefore, the sliding displacement of the detection pin 47 and the shaft 44 owing to the seating phase of the panel W3 with respect to the seating flange portion 35 enables the proximity switch 48 to be turned on or turned off for detection of the seating or unseating state of the panel W3.

[0047]

In accordance with the vehicle body assembly machine thus constructed, consequently, when supplying the lower panel W1, which is the kernel of the dash panel D as shown in Fig. 1, to the jig base 1 using the handling robot 4, the locating pin 26 of the locating unit 27 is positioned and retained in such a position as to allow each of the locators 6A, 6B to position the lower panel W1 to the final relative position completed location P1 with respect to the other panels. On the other hand,

the locators 8A, 8B for positioning the cross member and the locators 9A, 9B and 10A, 10B for positioning the side panels position and retain the locating pin 26 of the relevant locating unit 27 at the work set positions P2, P3 differing from the position completed location P1, respectively.

[0048]

That is, the respective locators 8A, 8B for positioning the cross member support and retain the locating pins 26 of the relevant locating units 27 at respective positions retreated from the relative positioning final location P1 between the panels by a given amount in the Y direction and dropped from the relative positioning final location P1 by a given amount in the Z direction. On the other hand, the respective locators 9A, 9B and 10A, 10B for positioning the side panel support and retain the respective locating pins 26 of the relevant locating units 27, at respective positions retreated from the relative positioning final location P1 between the panels by a given amount in the X direction and dropped from the relative positioning final location P1 by a given amount in the Z direction.

[0049]

Then, when the lower panel W1 is supplied to and set on the jig base 1 by the handling robot 4, the locating bores R, previously formed at given locations of the lower panel 1 as shown in Fig. 9, are brought into engagement with the locating pins 26 of the respective locators 6A, 6B and 7A, 7B and, simultaneously, the embossed portions E formed surrounding the locating bore R are seated to the seating flanges 35 of the base portions of the locating pins 26. As such, a primary positioning operation is completed for the lower panel W1 in conjunction with the locators 6A, 6B and 7A, 7B for the positioning of the lower panel. When this takes place, the

clamp units 28, located adjacent to the respective locators 6A, 6B and 7A, 7B for the positioning of the lower panel remain in the unclamped states.

[0050]

Upon completion of the primary positioning step of the lower panel W1, which forms the kernel of the dash panel D, the operator manipulates to set the cross member W2 and the pair of left and right side panels W3, W4, which are the other panels, to the respective locators 9A, 9B and 10A, 10B. That is, the cross member W2 is set such that the locating bores R formed preliminarily are inserted into the locating pins 26 of the respective locators 8A, 8B remaining at the work set position P2 for the positioning of the cross member to allow the embossed portions E around the locating bores R to be seated on the seating flanges 35 as shown in Fig. 9. Also, the pair of side panels W3, W4 are set such that the locating bores R formed preliminarily are inserted into the locating pins 26 of the respective locators 9A, 9B remaining at the work set position P3 for the positioning of the side panels to allow the embossed portions E around the locating bores R to be seated on the seating flanges portion 35 as shown in Fig. 9.

[0051]

A typical view of a condition wherein the primary positioning operation has been completed in conjunction with the lower panel W1 and the cross member W2 and the pair of left and right side panels W3, W4, which constitute the component elements of the dash panel, is shown in Fig. 1. As shown in Fig. 1, while the lower panel W1 remains in the relative positioning final location P1, the other remaining cross member W2 and the side panels W3, W4 remain in the respective work set positions P2, P3. As a result, the respective panels W1 to W4 remain in the conditions before carrying out the relative

positioning operation among the panels and remain in the positions separate from one another.

[0052]

Consecutively, when the start switch (not shown) is turned on by the operator M after the setting of the respective panels W1 to W4 has been completed, the clamp arm 39, which is contained in each of the locating pins 26 as shown in Fig. 9, is operated for clamping action, clamping the embossed portion E, formed around the locating bore R, between the clamp arm 39 and the seating flange 35. At the same time, the pair of clamp units 28, located adjacent to the locators 6A, 6B and 7A, 7B for the positioning of the lower panel operates for the clamping action, thereby clamping the lower panel W1. In such a manner, the final positioning and clamping operations are completed for the corresponding panels W1 to W4 with respect to the respective locators 6A, 6B and 10A, 10B.

[0053]

At this time, the work seating detection mechanisms 49 mounted at the respective locating pins 26 as shown in Fig. 9 are actuated to detect the presence or absence of the relevant panels W1 to W4 associated with the respective locators 6A, 6B to 10A, 10B. If the presence of the seating of any panel relevant to the locating pin 26 is not detected by any possibility, a given alarm is produced to urge the operator M to confirm the presence of the panel with respect to the relevant locator.

[0054]

Subsequently, upon confirmation of the presence of all the aforementioned panels W1 to W4, first, the cross member W2, which is positioned and retained with the locating pin 26 of

the locating unit 27, is moved together with the locating pin 26 forward into the relative positioning final location P1 in the X direction while raising the locating unit 27, remaining at the tip end, by a given height in the Z direction in a mutual synchronism with the pair of locators 8A, 8B for the positioning of the cross member. Thus, the cross member W2 is pressed onto the lower panel W1, which has been already retained at the relative positioning final location P1 as shown in Fig. 12(A), implementing the mutual positioning operation between the lower panel W1 and the cross member W2. When this takes place, the mutual positioning completed condition between the lower panel W1 and the cross member W2 is self-retained with the locators 6A, 6B, 7A, 7B and 8A, 8B which support the respective panels W1, W2 in their positioned states.

[0055]

Further, since the locators 8A, 8B for the positioning of the cross member once raises the cross member W1 in the Z direction and then moves the same forward in the X direction, it is possible for the work set position P2 for setting the cross member W2 at the locators 8A, 8B for positioning the cross member to be settled at a height lower than the final relative positioning completed location P1, with a resultant reduction in load of the operator M with an improved workability. It goes without saying that the height of the work set position P2 may be settled to an arbitrary position depending on a physical body of the operator M.

[0056]

Upon completion of the mutual positioning step between the aforementioned lower panel W1 and the cross member W2, the left and right locator pairs 9A, 9B and 10A, 10B for the positioning of the side panels are mutually synchronized and actuated to raise the locating units 27 at the tip end by the

given amount in the Z direction in the same manner as previously noted. At the same time, the side panels W3, W4, which are positioned and supported with the locating units 27 and hence the locating pins 26, are moved with the associated locating pins 26 forward to the relative positioning completed location P1 in the Y direction such that the side panels W3, W4 are pressed against the lower panel W1 and the cross member W2 which have been already located at the relative positioning completed location P1 as shown in Fig. 12(B) to allow the pair of left and right side panels to be relatively positioned in the Y and Z directions with respect to the lower panel W1 and the cross member W2 which have already remained in the relative positioning completed condition.

[0057]

Consecutively, when the relative positioning operation of the side panels W3, W4 has been completed with respect to the Y and Z direction in the manner described above, the left and right locator pairs 9A, 9B and 10A, 10B move the side panels W3, W4, which are positioned and retained with the locating units 27 at the tip end and, hence, the locating pins 26 forward to the relative positioning final location P1 in the X direction together with the locating pin 26 in synchronism with the left and right locator pairs 9A, 9B and 10A, 10B for the positioning of the side panels in the same manner as described above to allow the side panels W3, W4 to be pressed, in the X direction, against the lower panel W1 and the cross member W2, which have already remained at the relative positioning final location P1 as shown in Fig. 12(C). Thus, the relative positioning operation of the pair of left and right side panels W3, W4 is performed in the X direction with respect to the lower panel W1 and the cross member W2 which have already been in the relative positioning final state.

[0058]

With such positioning steps mentioned above, the final relative positioning operation is completed in the three-dimensional direction, i.e., X, Y and Z directions among the lower panel W1, the cross member W2 and the pair of left and right side panels W3, W4 which form the component elements of the dash panel, rendering the respective panels W1 to W4 to be held in intimate contact with one another at a regular joining position. Then, a welding command signal is applied to the welding robot 5, shown in Fig. 1, which remains at a stand-by condition, thereby implementing spot welding steps to join the joining parts of the respective panels, consequently completing the assembly of the dash panel D, composed of the component elements, involving the aforementioned lower panel W1 and the cross member W2 and the pair of left and right side panels W3, W4.

[0059]

In the embodiment, it is, of course, possible for the three-dimensional positions of the locating units 27 (including the locating pins 26) remaining at the distal ends of the respective locators 6A, 6B to 10A, 10B to be arbitrarily altered. In addition, the presence of the original functions of the locating pins 26 as well as the substantial clamping functions of the clamping means composed of the built-in clamp arms 39 and work seating detection mechanism 49 allow the detection pins 47 of the clamp arms 39 and the work seating detection mechanism 49 to effectively operate in the areas of the seating flange portions 35 of the root portions of the locating pins 26. Thus, no excessive portions thereof protrude outside the locating pins 26, resulting in a miniaturized and simplified structure in the locating unit 27 itself.

[0060]

Accordingly, for example, even in a case where an assembly work is performed for the dash panel D of a car model different from the dash panel D which has been assembled or in a case where the dash panels D of different car models are assembled in a so-called mixed flow production system, preliminarily normalizing the size of the locating bores R and the size of the embossed portions E among the component elements of the dash panels of the various car models enables the locating pins 26 to be commonly used for the vehicle bodies of all car models without the need for any remodel in the work clamping functions and the work seating detecting functions, resulting in an extremely advantageous effect in general-purpose properties in accommodations.

[Brief Description of the Drawings]

[Fig. 1]

Fig. 1 is a plan view for illustrating a schematic structure of a vehicle body assembly machine according to an embodiment of the present invention;

[Fig. 2]

Fig. 2 is a plan view for illustrating a locator jig which forms the kernel of the vehicle body assembly machine shown in Fig. 1;

[Fig. 3]

Fig. 3 is a front view for illustrating the locator jig of Fig. 2;

[Fig. 4]

Fig. 4 is a right side view for illustrating the locator

jig of Fig. 2;

[Fig. 5]

Fig. 5 is a plan view for illustrating a detailed structure of a locator for positioning a side panel shown in Fig. 2;

[Fig. 6]

Fig. 6 is a front view of the structure of Fig. 5;

[Fig. 7]

Fig. 7 is a left side view of the structure of Fig. 6;

[Fig. 8]

Fig. 8 is an enlarged view for illustrating a locating unit to be used in respective locators shown in Figs. 2 to 4;

[Fig. 9]

Fig. 9 is an enlarged partial cross-sectional view of the locating unit of Fig. 8;

[Fig. 10]

Fig. 10 is a left side view of the locating unit of Fig. 9;

[Fig. 11]

Fig. 11 is an enlarged view for illustrating a clamp arm shown in Fig. 9;

[Fig. 12]

Figs. 12 are views for illustrating a sequence of assembling panels in the vehicle body assembly machine shown in Fig. 1; and

[Fig. 13]

Fig. 13 is a structural view for illustrating an example of a locating unit of the prior art.

[Description of the Reference Numerals]

1: jig base
6A: locator for positioning lower panel
6B: locator for positioning the lower panel
7A: locator for positioning the lower panel
7B: locator for positioning the lower panel
8A: locator for positioning cross member
8B: locator for positioning the cross member
9A: locator for positioning side panel
9B: locator for positioning the side panel
10A: locator for positioning the side panel
10B: locator for positioning the side panel
15: X-axial unit
20: Y-axial unit
25: Z-axial unit
26: locating pin
27: locating unit
35: seating flange portion
35a: work seating surface
39: clamp arm (clamp means)
44: shaft
47: detection pin
48: proximity switch
49: work seating detection mechanism (work seating detection means)

D: dash panel
E: embossed portion
P1: relative positioning final location
P2: work set position
P3: work set position
R: locating bore
W1: dash lower panel
W2: dash upper cross member (work)
W3: cowl top side panel (work)
W4: cowl top side panel (work)

[Name of Document] ABSTRACT

[Abstract]

[Object] To provide a locating pin having a locating pin function, a clamp function and a work seating detection function, wherein the locating pin has a structure acceptable to multi-species of works as it is.

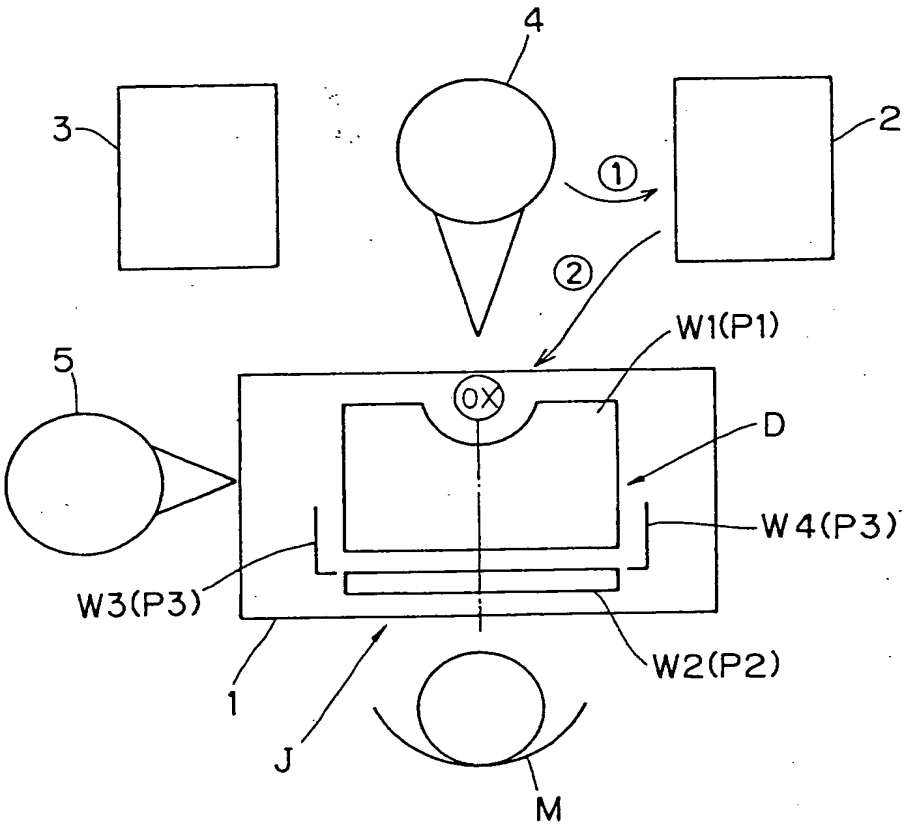
[Solving Means] A locating pin 26 is formed with a seating flange portion 35 having a work seating surface 35a and has a built-in clamp arm 39 to be operable in a clamping or unclamping movement responsive to an expansion and contraction of a clamp cylinder 34. A detection pin 47 is mounted for a protruding and retracting movement from the work seating surface 35a, with the detection pin 47, a shaft 44 and a proximity switch 48 forming a work seating detection mechanism 49. A mutual engagement between the locating pin 26 and a locating bore R allows a panel W3 to be positioned, simultaneously detecting the presence of seating of the panel W3 responsive to a movement of the detection pin 47.

[Selected Figure] Fig. 9

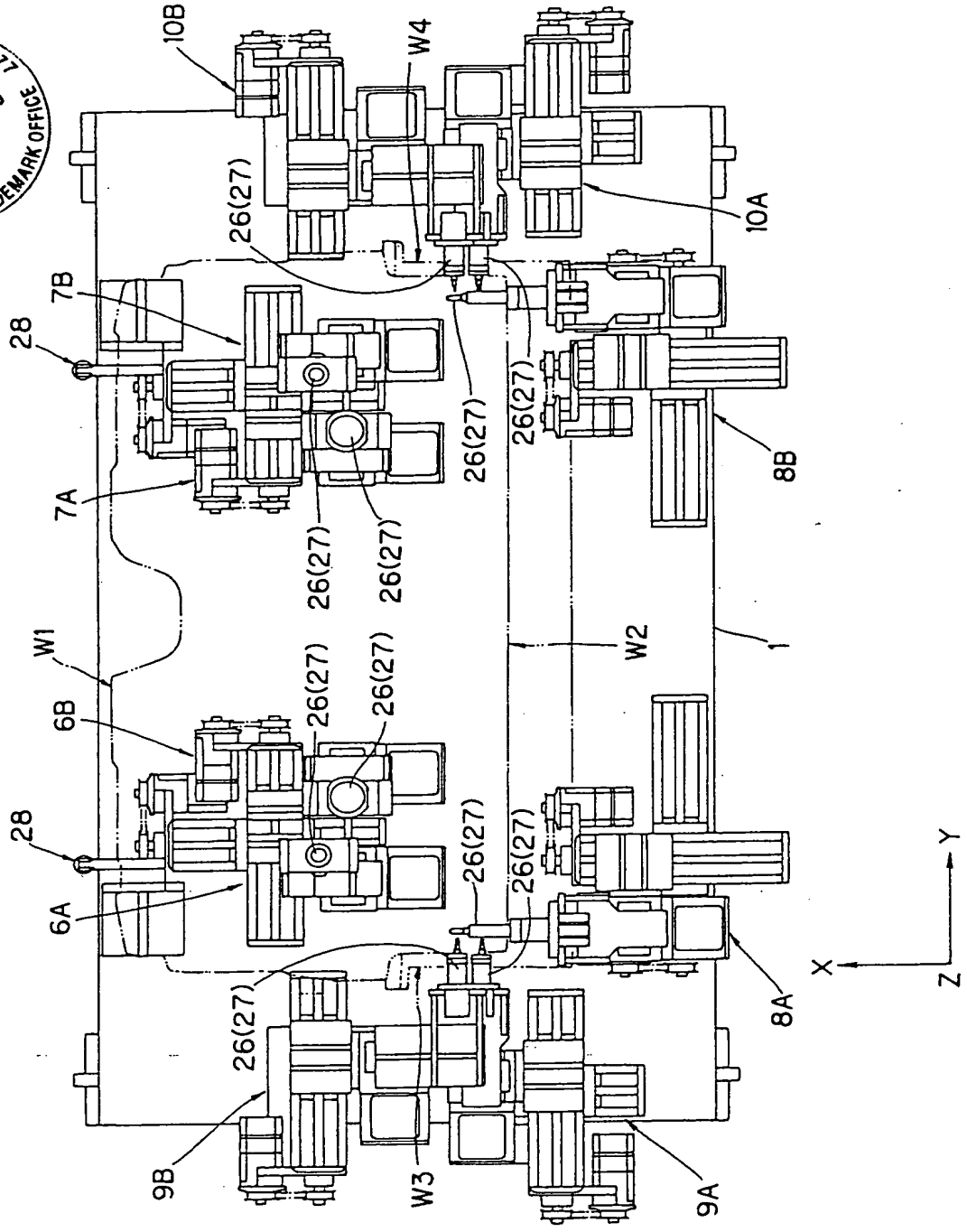
提出日　平成１３年　１月３１日

整理番号＝ＮＭ００－０１０３３

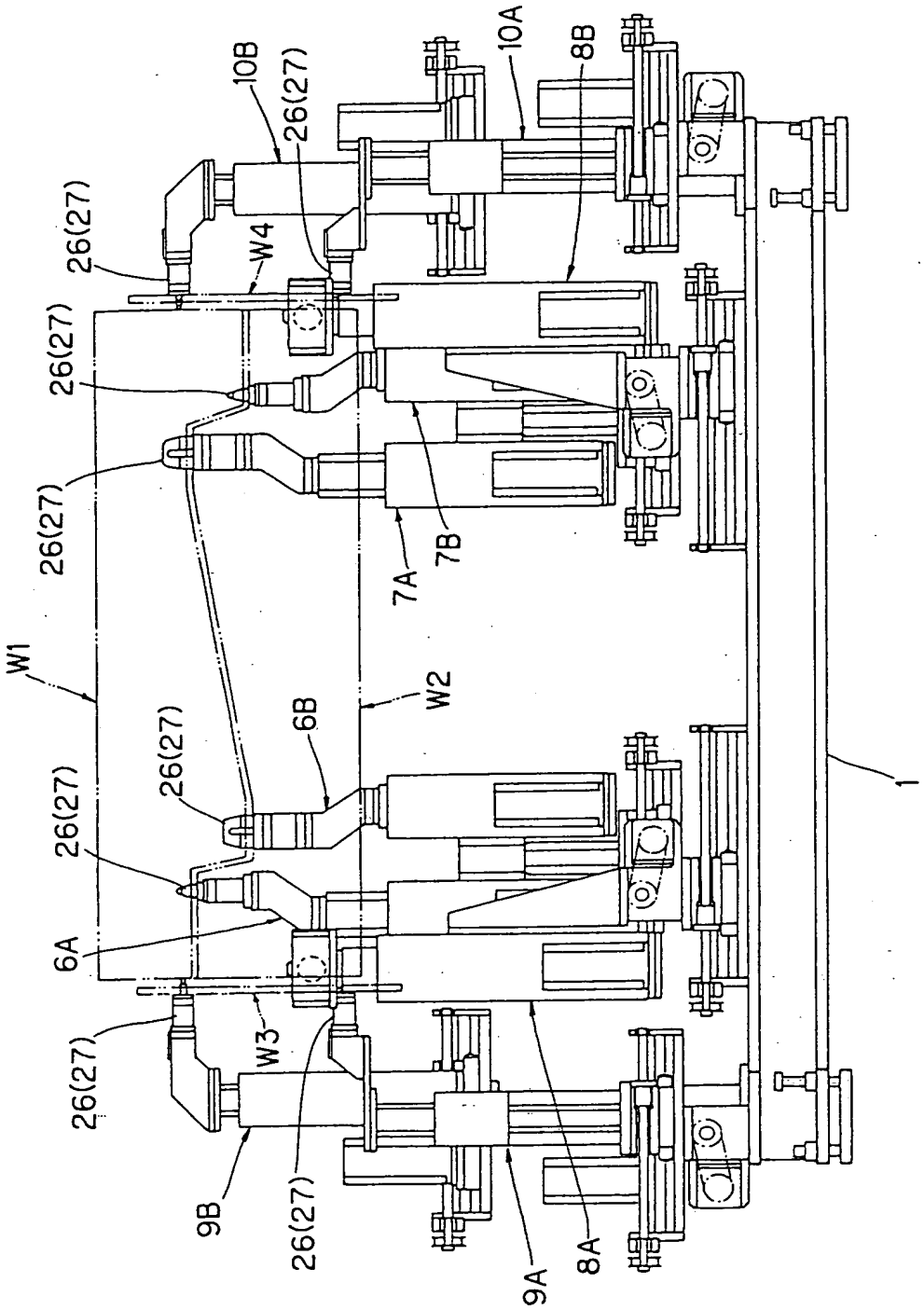
【書類名】　図面
[Name of Document]　DRAWINGS
【図１】
[Fig. 1]



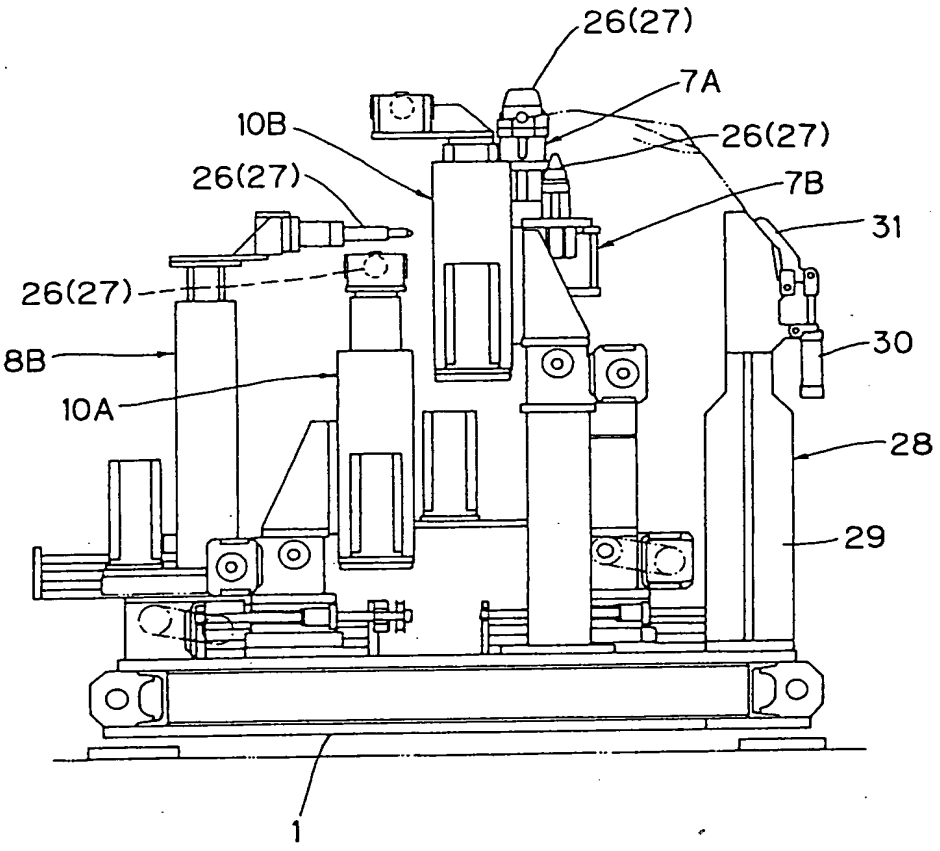
【図２】 [Fig. 2]



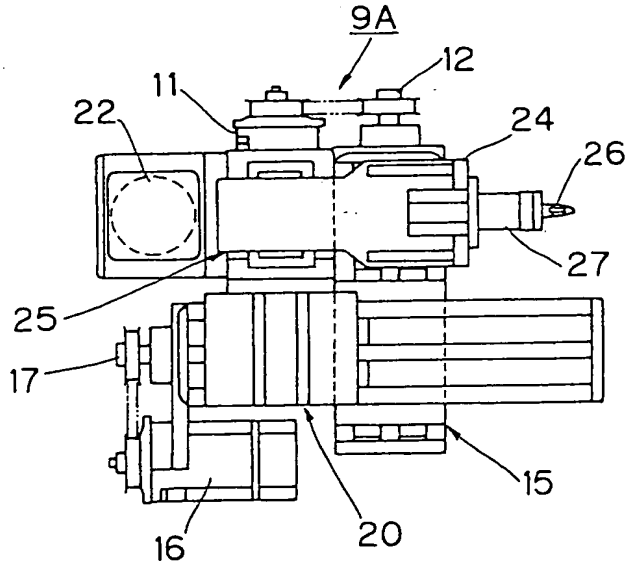
【図３】 [Fig.3]



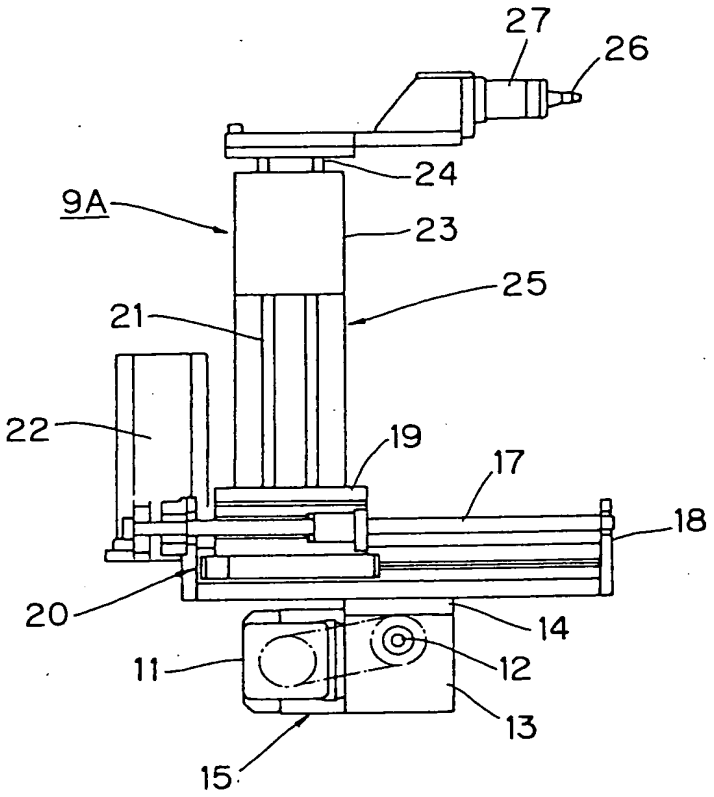
【図４】 [Fig.4]



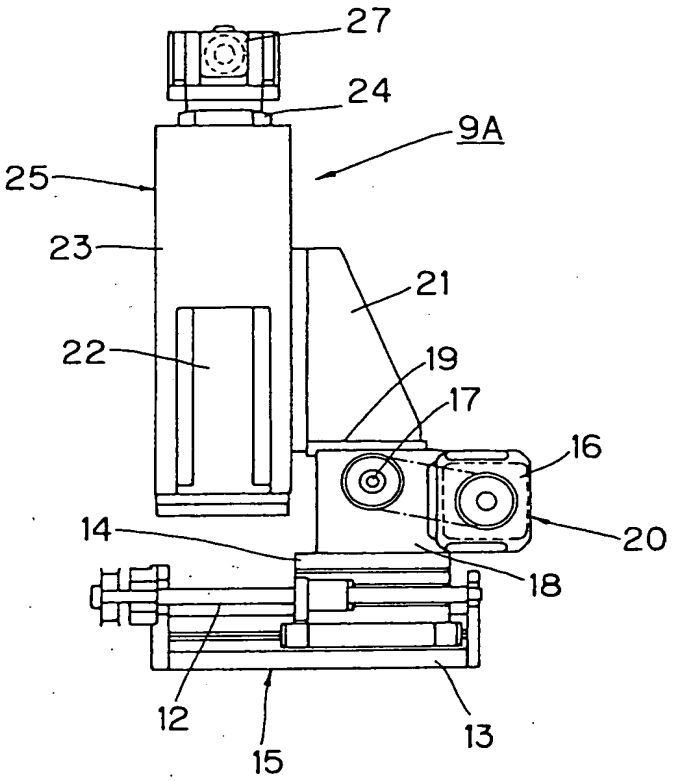
【図５】 [Fig.5]



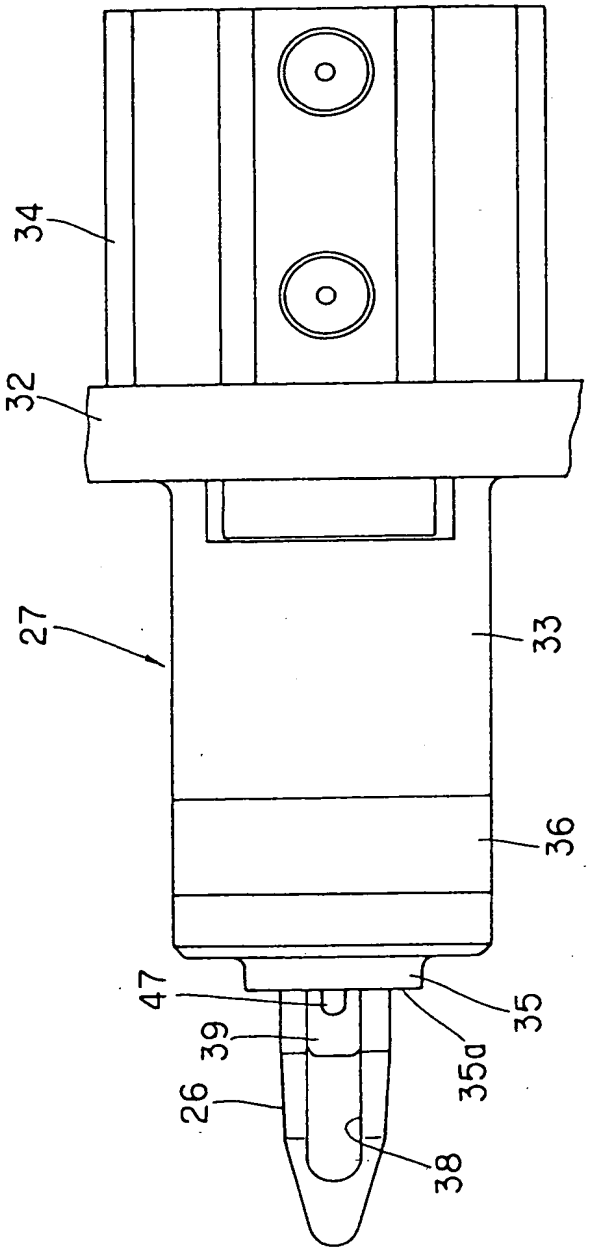
【図６】　[Fig.6]



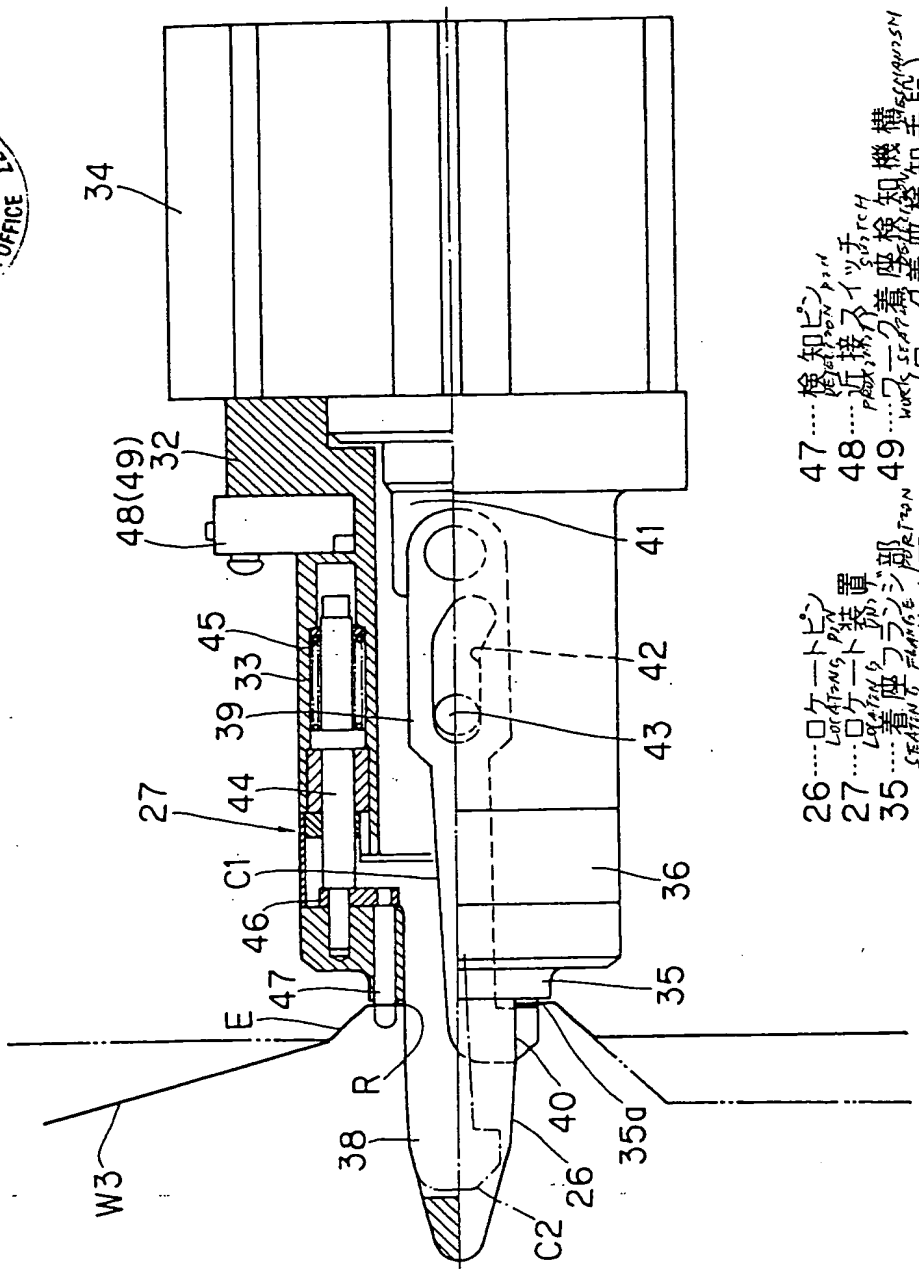
【図７】　[Fig. 7]



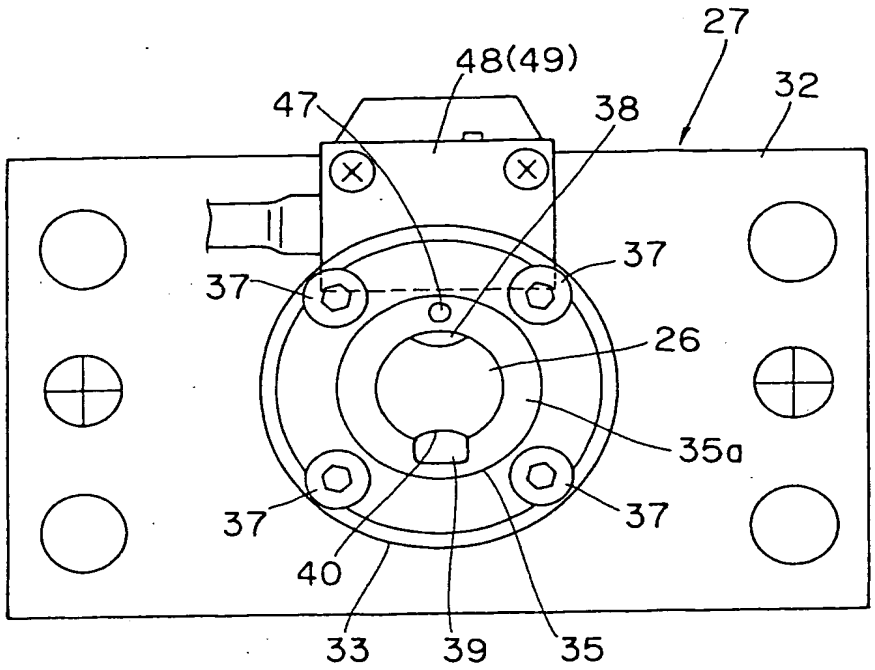
【図８】　[Fig. 8]



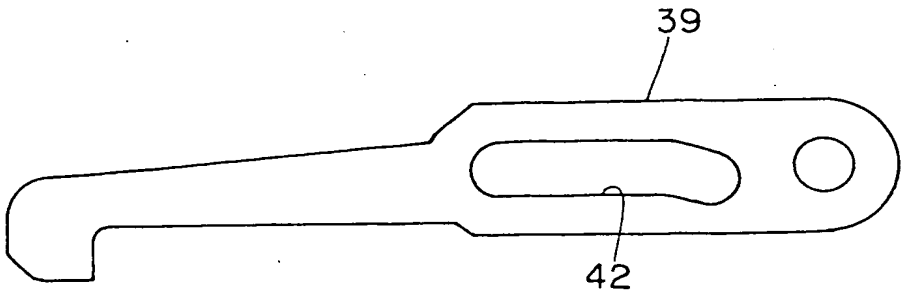
【図９】 [Fig. 9]



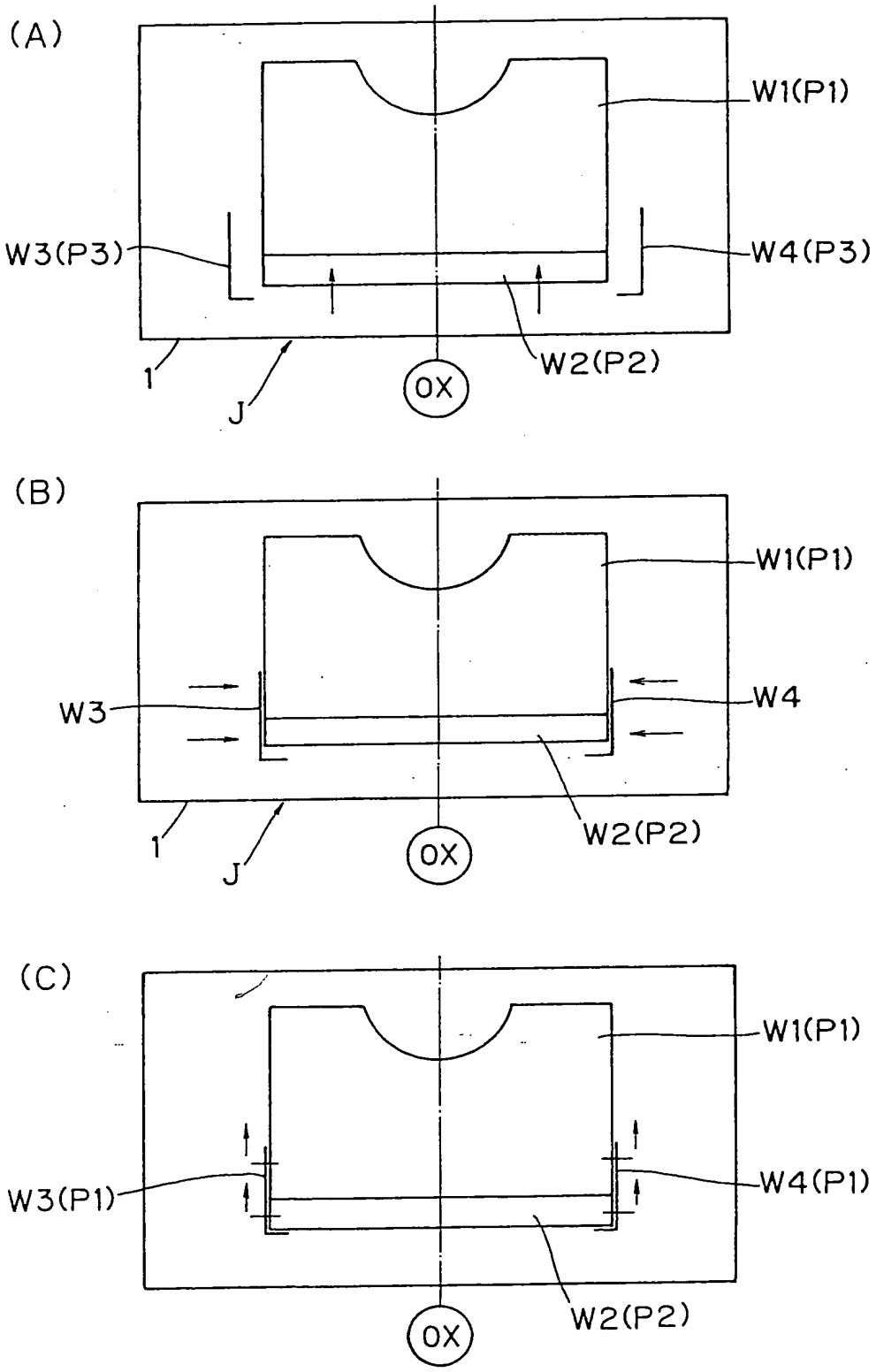
【図１０】　[Fig. 10]



【図１１】　[Fig. 11]



【図１２】 [Fig.12]



【図１３】　[Fig.13]